



# **GLAST Large Area Telescope Calorimeter Subsystem Functional / Performance Testing**

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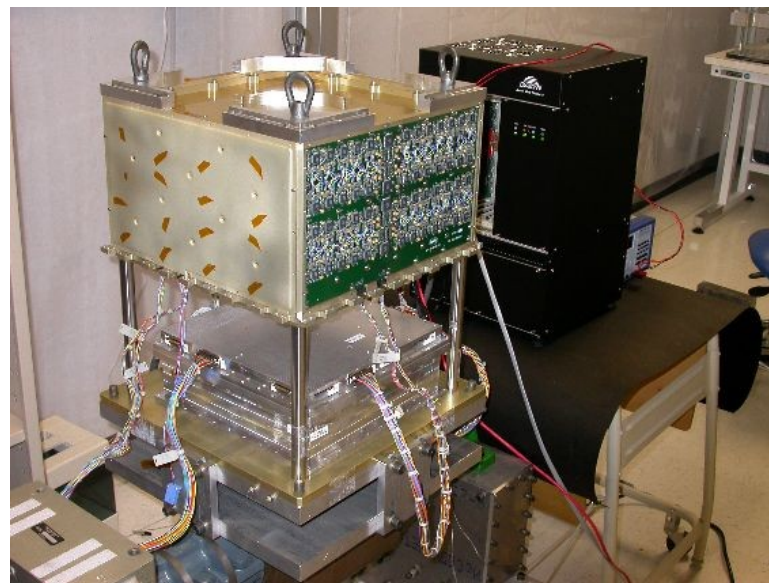




# Functional Testing and Calibration

## ❑ Module-level functional and performance testing

EM CAL during  
Functional test



- ❑ Functional testing addressed in LAT-MD-01370
  - Defines comprehensive and limited tests (CPT, LPT)
- ❑ Calibration is addressed in LAT-MD-04187
  - Defines electronic (ECS) and muon calibration (MuC)





# Functional Requirements and Traceability

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## ❑ Requirements

- Relevant, testable requirements extracted from Level III and Level IV specs
- Verification matrix in LAT-MD-01374

## ❑ Traceability

- Functional test suites generate test report summarizing results and compliance with relevant specifications
  - Pass/fail overall and by test element
- Traceability maintained element-by-element through LAT-SS-01502





# Functional Test Flow

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- ❑ **Comprehensive Functional and Performance Test (CPT)**
  - **Test suite composed of 22 elements with following goals**
    - Verify full functionality of all CAL registers and proper communication with TEM
    - Measure pedestal centroids and widths
    - Verify stability of optical bonds for all CDEs
    - Measure electronic gain, linearity, and integral non-linearity of each GCFE
    - Characterize low and high energy (FLE and FHE) discriminators
    - Characterize zero-suppression (LAC) threshold DAC
    - Characterize auto-ranging (ULD) discriminator DAC
    - Estimate event dead-time
    - Test overload recovery circuitry
  - **Suite executes complete test sequence without user intervention**
    - Run time ~ 2 hours



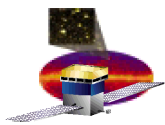


# Functional Test Flow (cont.)

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- ❑ **Limited Functional and Performance Test (LPT)**
  - **Test suite composed of 6 elements with following goals:**
    - **Verify functionality of all CAL registers and proper communication with TEM**
    - **Measure pedestal centroids and widths**
    - **Verify stability of optical bonds for all CDEs**
  - **Suite executes complete test sequence without user intervention**
    - **Run time ~ 15 minutes**



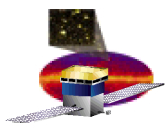


# Calibration Flow

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- ❑ **Electronic Calibration (ECS)**
  - **Test suite to give detailed calibrations of**
    - Electronic gain, linearity, and integral non-linearity of each GCFE
    - Low and high energy (FLE and FHE) discriminators
    - Zero-suppression (LAC) threshold DAC
    - Auto-ranging (ULD) discriminator DAC
- ❑ **Muon Calibration (MuC)**
  - **Calibrates “optical gain” of each CDE**
    - Optimizes time delay between trigger and peak hold
    - Verifies calibration (energy units) in FLE/FHE from ECS
    - Fits muon peak (with its known energy deposition), gives MeV/bin.
    - Maps light taper and light asymmetry in each CDE
- ❑ **These calibrations are run at start and end of environmental test program**
  - **Reference calibration just prior to shipment to SLAC**



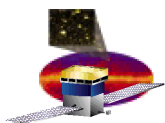


# Functional Testing to Date

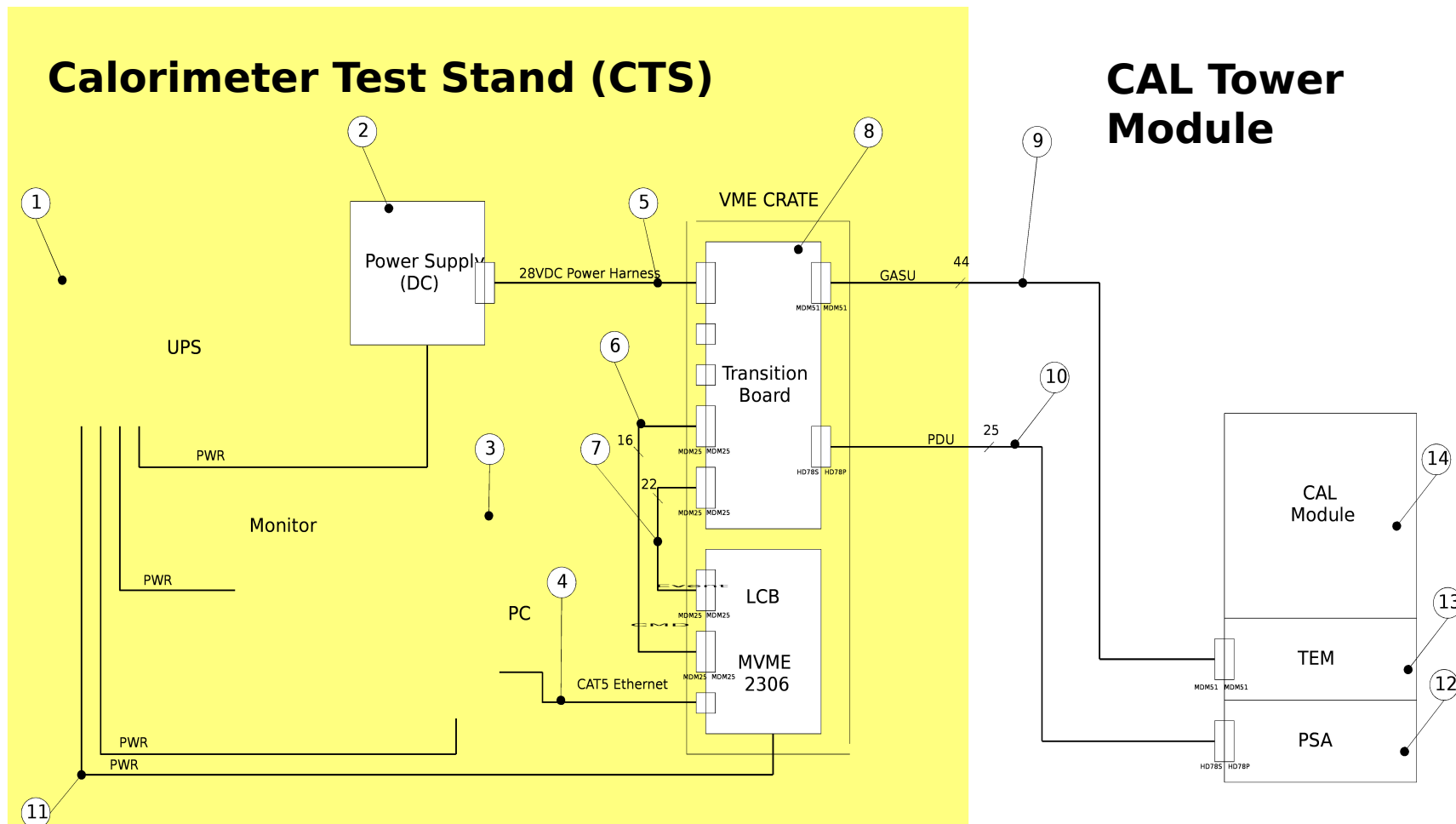
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- ❑ **Engineering Model CAL Module**
  - **Full suite of functional tests and calibrations conducted through environmental test program**
  - **Gave opportunity to practice and/or redefine algorithms and flow of test suite**
  - **Demonstrated compliance with performance specifications**
  
- ❑ **Flight Component Testing**
  - **Flight AFEE board-level testing uses essentially identical test suite**
  - **Last opportunity to refine suite for Module-level test**
  - **Testing in progress**





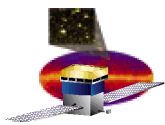
# CAL Module Functional Test Configuration



**LAT-DS-01960-01**







# Functional Test Facility Status

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- ❑ **TEM/TPS (version EM2)**
  - **How many?**
    - 8 units exist at NRL for use with FM CAL Modules
      - 1 is verified for environmental test
      - 7 are under receiving/workmanship test
        - » 3 will be returned to SLAC (1 comm prob, 2 connector damage)
- ❑ **Calorimeter Test Stand**
  - **How many?**
    - 13 exist at NRL
      - 6 are in simultaneous use during nominal Module A&T program
      - 5 are in simultaneous use for TEM and AFEE testing
- ❑ **Scenario**
  - **TEM/TPS attached to CAL Module**
    - Ships to SLAC, but must return ASAP
  - **CTS dedicated to each test area (e.g. vibe, TVAC)**
    - CAL Tower Module moves in, tests, moves out
- ❑ **Status**
  - **Ready to go**





# Test Software Status

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## ❑ Configuration Management

- LATTE 4 is controlled by LAT I&T at SLAC
- CAL Scripts are configured at NRL (CVS) with releases to SLAC CVS
  - Script suites are in use at NRL
- Documentation
  - LAT-MD-01370, CPT and LPT
  - LAT-MD-04187, ECS and MuC
  - LAT-TD-01502, test descriptions

## ❑ Status

- CAL scripts run successfully under LATTE 3-02
- CAL scripts still being verified against latest LATTE release
- FMA test will proceed with LATTE 3-02



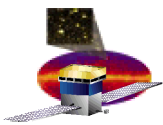


# Known Risks and Limitations

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- ❑ **Functional test (and calibration) uses EM2 TEM and TPS**
  - **May not reflect actual performance of the flight TEM/TPS**
  - **Fewer TEM/TPS than CAL Modules**
    - Too few??
    - TEM/TPS must return to NRL for reuse ASAP
- ❑ **LATTE and CAL package not yet frozen**
  - **LATTE current rev: 4-01**
  - **CAL runs at NRL with LATTE v. 3-02**
    - **NRL and SLAC have agreement to work together to get stable s/w system**
  - **NRL and SLAC s/w systems will be different for FMA**





# Functional Test Status

ITEM	STATUS
Requirements	Defined
Pass-Fail Criteria	Defined
Testing to Date	EM successful
Configuration	Defined
Handling/Installation	Defined
Facility Status	S/W scripts being verified against current rev of LATTE
Test Equipment	Ready
Risks and Limitations	<ol style="list-style-type: none"><li>1. Test and calibration use EM2 TEM/TPS</li><li>2. TEM/TPS must return to NRL ASAP</li><li>3. S/W not yet frozen</li></ol>
Procedures	Configured
Status	System is ready to execute tests

